

MAINTENANCE REPAIR BEST PRACTICES

By Ricky Smith CMRP, CMRT



INTRODUCTION

- **I am Ricky Smith**
 - CMRT, CMRP, CRL
- **Began my career in Maintenance in the US Army as a Heavy Equipment Mechanic**
- **Maintenance Technician at Exxon**
- **Maintenance Technician at (Alcoa) Alumax Mt Holly (World Class Maintenance Plant)**
- **Other Maintenance Positions:**
 - Maintenance Supervisor
 - Maintenance Manager
 - Maintenance Company Commander – US Army Reservice
- **Book Author:**
 - Industrial Machinery Repair
 - Rules of Thumb for Maintenance and Reliability Engineer
 - Lean Maintenance
 - Numerous Maintenance Tool-Box Talks (single point lessons)

WHAT ARE MAINTENANCE BEST REPAIR BEST PRACTICES?

“Maintenance Repair Practices which have been demonstrated to be effective by Maintenance Technicians and Followed by the Best Maintenance Organizations in the world”



ALIGNMENT THROUGH DEFINITIONS

"Without a Definition everyone has their own Opinion"

Definitions of Maintenance Words and Terms must be aligned otherwise everyone has their own definition and opinion

- **“Maintenance”** - the process of maintaining or preserving something, or the state of being maintained.
- **“Preventive Maintenance”** - Actions performed on a time- or machine-run-based schedule that detect, preclude or mitigate degradation of a component or system with the aim of sustaining or extending its useful life through controlling degradation to an acceptable level. (Source: SMRP Metrics)
- **“Predictive Maintenance”** - An equipment maintenance strategy based on measuring the condition of equipment against known standards in order to assess whether it will fail during some future period and taking appropriate action to avoid the consequences of that failure. The condition of the equipment could be measured using condition monitoring, statistical process control, equipment performance or through the use of human senses. **The terms condition-based maintenance (CBM), on-condition maintenance and predictive maintenance (PdM) can be used interchangeably.** (Source: SMRP Metrics)

HOW LONG SHOULD EQUIPMENT LAST?



1. Equipment fails based on the weakest link, typically a part or component
2. Depends on many things?
 - Was it installed to specification?
 - Was a verification process used to ensure it will function as required (NO DEFECTS)?
 - Visual inspection
 - PdM Verification and Baseline Established
 - **Does operators operate the equipment to specifications?**
 - **Does maintenance maintain to specifications?**
3. A large % of equipment problems come from Human Induced Failures
 - Maintenance Example: Bearing Failure due to improper installation
 - Production Example: Equipment not running to rate due to lack scorecards for OEE, Rate, Scrap, etc.
 - Lack of Discipline in the plant
 - No repeatable procedure

WHAT ARE MAINTENANCE REPAIR BEST PRACTICES?

- Maintenance Technician practices which results in less equipment problems/failures
- Performing Maintenance using repeatable procedures based on Lessons Learned
- Utilization of Specifications to ensure equipment is inspected / restored / maintained to meet Production's expectations

Steps to Create Effective Maintenance Procedures

1. Create a Maintenance Procedure Optimization Team
 - Best Maintenance Technician or Technicians
 - Reliability or Maintenance Engineer
 - Safety Leader
 - Maintenance Planner
2. Identify the requirements for the Maintenance Procedure
 - Procedure Category (CM, PM, EM, PdM, etc.)
 - Steps by steps instructions (noun, adjective and verb)
 - Create basic procedure templates (ie. Replace Chain, Replace Electric Motors)
3. Track MTBF of parts/component types by tracking parts checked out from storeroom
 - post trend chart for all to see

Preventive Maintenance Procedure Example

PM Line 3		PM Line 3		PM Line 3																																											
Equipment Block ID: Plant 102 - Line 3		Required Departmental Coordination: Production shutdown / position / blow off equipment		Coordinate (See Form)																																											
Equipment Hierarchy: E560000		Other Procedures Referenced: None		Coordinate (See Line)																																											
Project Description: Preventive Maintenance - Inspect Line 3 Shear Pins		<table border="1"> <thead> <tr> <th>ID</th> <th>Description</th> <th>Craft</th> <th># of Cycles</th> <th>Clock Hours</th> <th>Craft Hours</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Clean area to be inspected using compressed air or degreaser as required. Warning: use force shield when blowing with compressed air Warning: ensure hydraulic cover doors are locked and tag out before proceeding</td> <td>Mech</td> <td>1</td> <td>0.2</td> <td>0.2</td> </tr> <tr> <td>2</td> <td>Inspect shear pin plates. Visually check for cracks on shear pin plates. Are any cracks evident? Yes ___ No ___</td> <td>Mech</td> <td>1</td> <td>0.3</td> <td>0.3</td> </tr> <tr> <td>2-2</td> <td>Insert 2 pry bar between plates to check for movement. Is any movement present? Yes ___ No ___</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3</td> <td>Inspect sprockets. Visually inspect for: Cracks Yes ___ No ___ Broken Teeth Yes ___ No ___ Visible Signs of Wear? Yes ___ No ___ If indicated, report findings below and to immediate supervisor for appropriate actions</td> <td>Mech</td> <td>1</td> <td>0.3</td> <td>0.3</td> </tr> <tr> <td>4</td> <td>Inspect retainer cap. Visually inspect for broken bolts. Are there any broken bolts? Yes ___ No ___ If broken bolts are found, replace as required Warning: use force shield</td> <td>Mech</td> <td>1</td> <td>0.2</td> <td>0.2</td> </tr> <tr> <td>4-2</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>		ID	Description	Craft	# of Cycles	Clock Hours	Craft Hours	1	Clean area to be inspected using compressed air or degreaser as required. Warning: use force shield when blowing with compressed air Warning: ensure hydraulic cover doors are locked and tag out before proceeding	Mech	1	0.2	0.2	2	Inspect shear pin plates. Visually check for cracks on shear pin plates. Are any cracks evident? Yes ___ No ___	Mech	1	0.3	0.3	2-2	Insert 2 pry bar between plates to check for movement. Is any movement present? Yes ___ No ___					3	Inspect sprockets. Visually inspect for: Cracks Yes ___ No ___ Broken Teeth Yes ___ No ___ Visible Signs of Wear? Yes ___ No ___ If indicated, report findings below and to immediate supervisor for appropriate actions	Mech	1	0.3	0.3	4	Inspect retainer cap. Visually inspect for broken bolts. Are there any broken bolts? Yes ___ No ___ If broken bolts are found, replace as required Warning: use force shield	Mech	1	0.2	0.2	4-2						Coordinate (See Line)	
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Frequency: Monthly		Estimated Craft Hours: 1 x 1.0		Estimated Elapsed Time: 1.0																																											
Estimated Production Downtime: 1		Originator: Dave Smith		Origination Date: 01/12/2020																																											
Previous Version(s) Modifications: DS		Maintenance Dept: 1		Version #: 1.0																																											
Approver: DS		Warnings: Failure to Lockout/Tagout could result in Death or Serious Injury		Caution: Failure to follow PM Requirements can result in equipment failure																																											
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		ES - 31256		1/2" x 2" 6r 5 socket head bolts																																											
		Quantity		Quantity Description																																											
		6		each																																											
Consumables Needed: Degreaser, paper towels		Special Tools Required: 2 pry bar 1 torque wrench		Mobile/Special Equipment:																																											

HUMAN INDUCED FAILURES

80% of equipment problems/failure are Human Induced, why?

Two Main Causes:

- Operators not operating equipment to specification
- Maintenance Techs not maintaining to specification

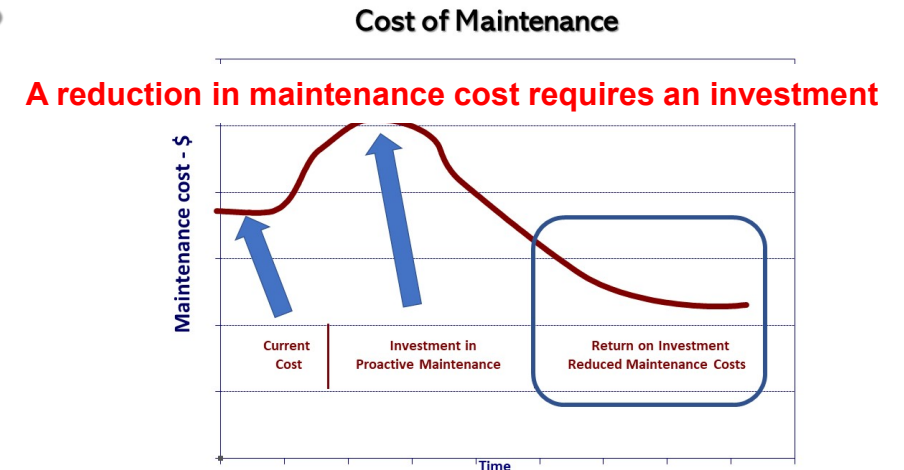
Solution: It is a team effort, no finger pointing

- Equipment is Maintained to specifications
- Operators operate to specification


Failures must be stopped unless your Maintenance Strategy is Run to Failure (RTF)

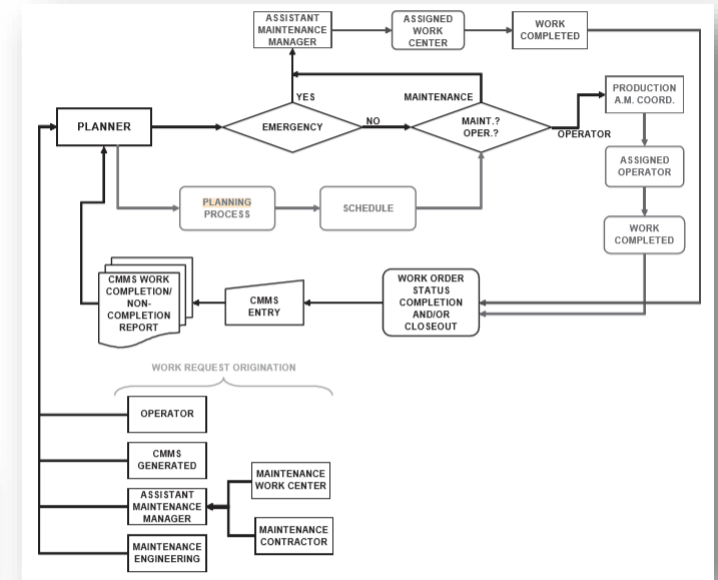
Maintenance Cost as a % of RAV –

- World Class = 1.7-3.4%
- Worst in Class = 11-16%



INVESTMENT REQUIREMENTS IN MAINTENANCE

1. User friendly CMMS 
2. Process Maps from Work ID to Failure Reporting
3. New technician training in your Maintenance Process
4. Maintenance Technician Ongoing Training



Tool-Box Talk
Preventive Maintenance 102

Preventive Maintenance (PM) / Operator Care (OpCare) is conducted by both trained and task qualified Maintenance Technicians and Production Operators with step by step instructions.

Preventive Maintenance Vision Statement
 A Holistic Integrated Approach that Identifies and Mitigates Defects that reduces Unscheduled Downtime and Reduces Total Cost of Ownership

Preventive Maintenance Mission Statement
 Preventive Maintenance is a controlled experiment with execution to specifications resulted in a desired outcome.

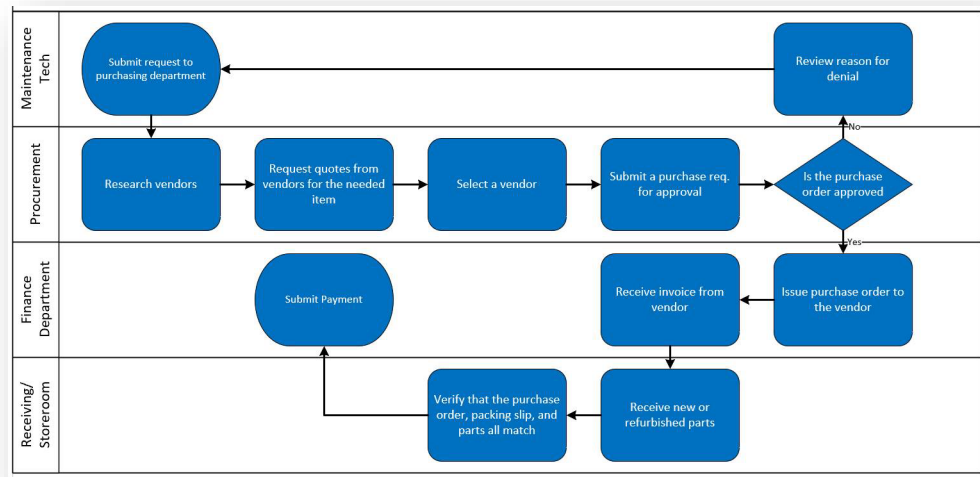
Preventive Maintenance Guiding Principles

1. Preventive Maintenance is the most important routine function that maintenance personnel must accomplish to specifications
2. Preventive Maintenance must meet expectations of Production consistently (Optimal Process Reliability)
3. Everyone (operators and maintainers) are trained in Maintenance Best Practices management

Preventive Maintenance Dashboard
 "You cannot Manage what you do not Measure"
 Using the right metrics in an organized manner will allow management to control the equipment without the equipment controlling management

PM is executed to specifications

- Ex. Tension? Deflection? good/bad? etc.
- PM inspections are conducted by trained individuals



MAINTENANCE TECHNICIAN GUIDING PRINCIPLES

1. **Maintenance Technician comes to work everyday with a position attitude**
2. **Performs Maintenance as a Controlled Experiment**
3. **Ensures all equipment is functioning to specifications**
4. **Begins each day with a positive attitude**
5. **If a patch must be made on equipment because of production needs a corrective work order is written to return the equipment to specifications**
6. **Maintenance Technicians follow the Maintenance Schedule**



REPEATABLE PROCEDURES

- Repeating procedures are used by all maintenance technicians while executing Preventive or Corrective Maintenance and not necessarily on breakdowns
- Breakdowns many times require a “PATCH” and thus a corrective work order must be written after a “PATCH” so the asset can be returned to a “Maintainable Condition” (Restoration)
- Maintenance Technicians write the Maintenance Procedures under guidance of reliability engineering or maintenance leadership

PM Line 3

Equipment Block ID: Plant 102 - Line 3			
Equipment Hierarchy: E360/XXX			
Project Description: Preventive Maintenance - Inspect Line 3 Shear Pins			
Job Description: PM Line 3			
Frequency: Monthly			
Estimated Craft Hours: 1 x 1.0		Estimated Elapsed Time: 1.0	
Estimated Production Downtime:			
Originator: Dave Smith	Maintenance Dept	Version #: 1	Origination Date: 01/12/2020
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Warnings: Failure to Lockout/Tagout could result in Death or Serious Injury			
Cautions: Failure to follow PM Requirements can result in equipment failure			
Personal Protective Equipment Required: gloves, face shield, hearing protection			
Part # (Stores ID)	Part Description	Quantity	Quantity Description
ES - 31256	1/2" x 2" Gr 5 socket head bolts	6	each
Consumables Needed: Degreaser, paper towels			
Special Tools Required: 2" pry bar, 1/2" torque wrench			
Mobile/Special Equipment:			

PM Line 3

Required Departmental Coordination: Production shutdown / position / blow off equipment				
Other Procedures Referenced: None				
ID	Description	Craft	# of Crafts	Clock Hours
1	Clean area to be inspected using compressed air or degreaser as required Warning: use face shield when blowing with compressed air Warning: Remove hydraulic pump drive motor (if cooked out) Top test before proceeding	Mech	1	0.2 0.2
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4	Inspect retainer cap Visually inspect for broken bolts Are there any broken bolts? Yes _____ No _____ If broken bolts are found, replace as required Replace bolts to 65 FT-LB	Mech	1	0.2 0.2
4-1				
4-2				

PM Line 3

Condition (as Found):
Condition (as Left):
Comments:
Craft's Feedback on Procedure:
Craft's Signature(s):
Date:

MANAGEMENT POST A CHART OF PARTS CHECKED OUT BY TYPE / MONTH NO COMMENTS FROM LEADERSHIP - THE DATA IS THE DATA

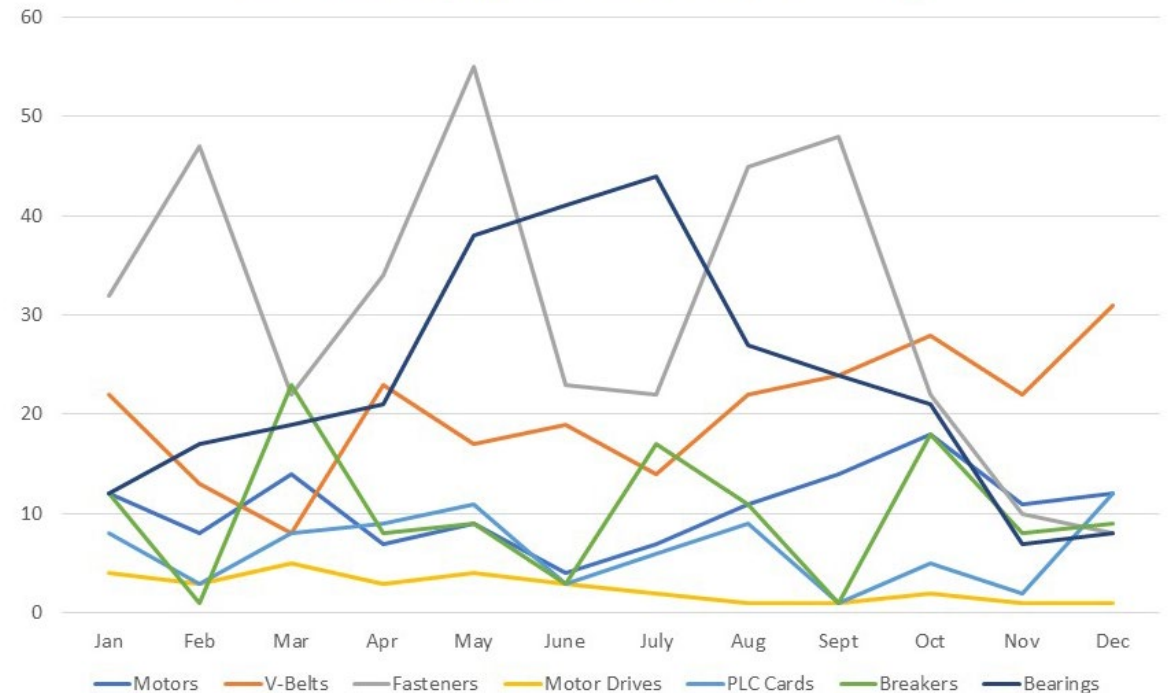
What does the chart tell you?

**"You can't
manage what you
can't measure."**

W. Edwards Deming

MetaOps
MetaExperts

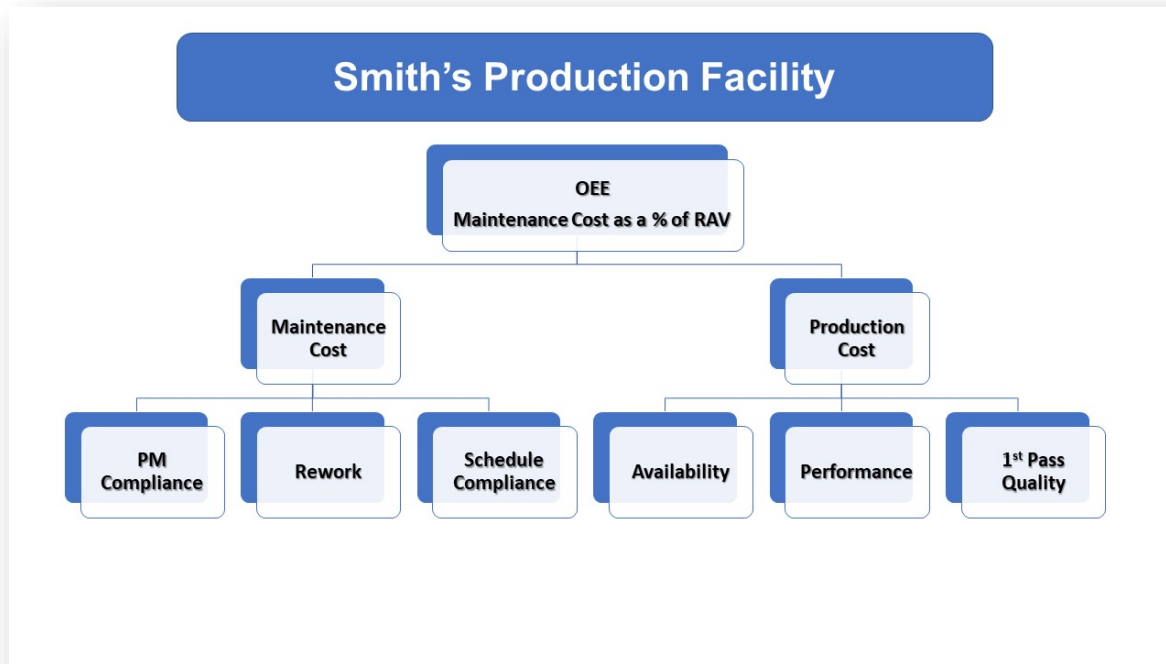
Number of Parts by Type Checked Out of Stores by Month



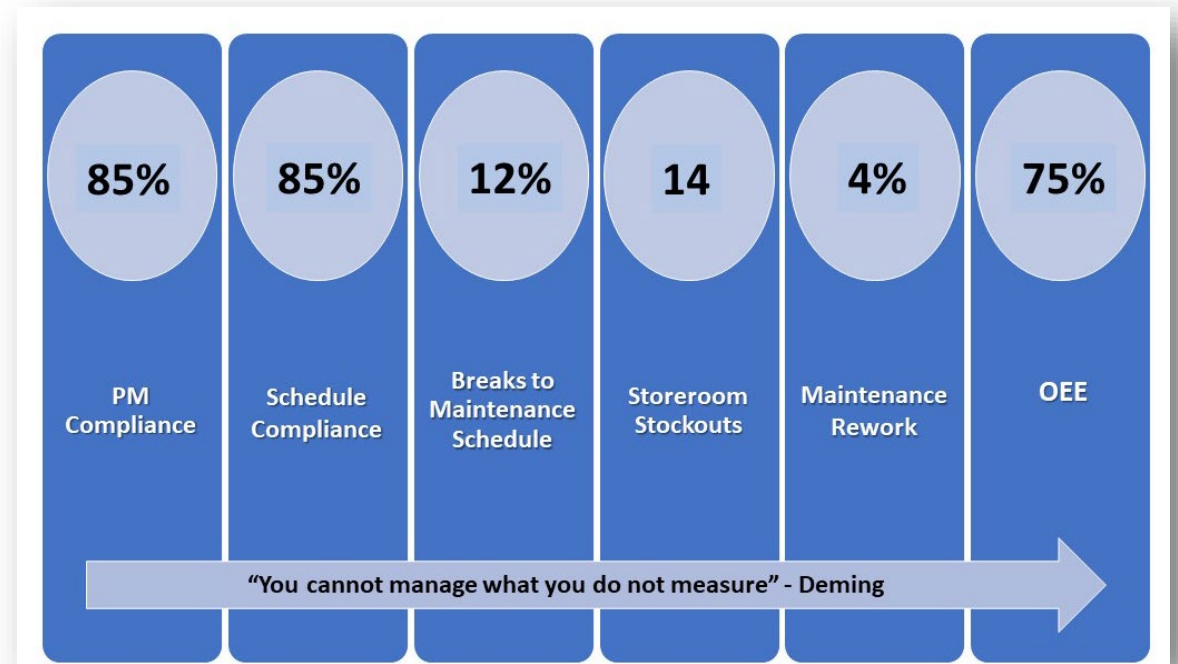
KPI SCOREBOARDS ARE POSTED SO PEOPLE KNOW THEIR SCORE

"TECHNICIANS NEED TO KNOW THEIR SCORE IN THE GAME"

Example of Scoreboards



Plant Level Scorecard



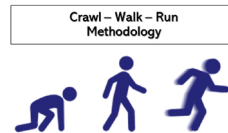
Maintenance Tech Scorecard

GENERAL RULES

- **The right Tool used for the Right Job**
- **No adjustable wrenches used unless approved (open end/box end wrenches)**
- **Torque Wrenches (must be calibrated)**
- **Welding Equipment (Ground lead must be within 6 inches of welded area)**
- **Repeatable Procedures for all Planned Work**
- **Weekly Technician Training – 30 minutes (Tool-Box Talks or Vendors)**
- **New Technician Testing (written and hands on) unless apprenticeship program in place**
- **No excuses for any issue, solutions only**
- **???**

MY RECOMMENDATIONS

- **Apply the Crawl, Walk, Run Methodology when changing anything**



- **Educate your team in Maintenance Best Practices**
- **Create a plan, as a team with your best 2 maintenance techs and the one with the worst attitude, maintenance supervisor, maintenance planner, production leadership (the one that is most open to change)**
- **Use you most influential tech to begin writing basic Maintenance Procedures**
- **In this plan the first step must be one that get's everyone's attention – you want everyone to be excited about the change**
- **Manage the plan with Leading and Lagging KPIs**
- **Challenge your technicians to sit for CMRT Exam**



QUESTIONS/COMMENTS?

Join me for this series of great Maintenance Best Practices Webinars

Week 3: Maintenance Repair Best Practices

- Tuesday, October 6 at 9AM (ET) or...
- Saturday, October 10 at 1PM (ET)

Week 4: Maintenance Storeroom Best Practices

- Tuesday, October 13 at 9AM (ET) or...
- Saturday, October 17 at 1PM (ET)

Week 5: Preventive Maintenance Best Practices

- Tuesday, October 20 at 9AM (ET) or...
- Saturday, October 24 at 1PM (ET)

Week 6: Root Cause Analysis Techniques/Fundamentals

- Tuesday, October 27 at 9AM (ET) or...
- Saturday, October 31 at 1PM (ET)

Week 7: How to Optimize a CMMS/EAM in Order to Manage an Effective Maintenance Organization

- Tuesday, November 3 at 9AM (ET) or...
- Saturday, November 7 at 1PM (ET)

Week 8: Lean Maintenance and How to Apply

- Tuesday, November 10 at 9AM (ET) or...
- Saturday, November 14 at 1PM (ET)